AN UNDERWATER LIGHT TRAP FOR COLLECTING BOTTOM-DWELLING AQUATIC INSECTS[1,2]

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ABSTRACT: A small, submerged light trap for collecting aquatic insects is described. It is designed especially for use on the bottom in still or moving water and is constructed of common materials. Among the insect taxa it has collected in quantity are EPHEMEROPTERA: Ephemerellidae, Heptageniidae, Leptophlebiidae, and TRICHOPTERA: Hydroptilidae. These families have not previously been reported from submerged light traps.

Submerged aquatic (subaquatic) light traps capture a wide variety of immature and mature acquatic organisms (Baylor and Smith, 1953; Hungerford *et al.*, 1955; Espinosa and Clark, 1972). Several workers have commented on the ability of such traps to collect larger numbers of some organisms than other sampling methods indicate are present (Husbands, 1967; Washino and Hokama, 1968; Weber, 1985). Small traps described in the literature have been round in cross section and were designed to capture insects swimming in the water column above the bottom (Hungerford *et al.*, 1955; Carter and Paramonov, 1965; Husbands, 1967; Washino and Hokama, 1968; Espinosa and Clark, 1972; Brown, 1976).

When placed on the bottom, round traps tend to roll about from wave action, current and substrate topography. Also, when on the bottom, the funnel used as a gate in a round trap requires that smaller, non-swimming animals travel a considerable distance across smooth, upward-angled material to enter the trap. This could result in reduced catches of such animals. A desire to specifically collect bottom-dwelling insects in both still and moving water led to development of the flat trap described here. It was designed primarily for use on the bottom, to reduce problems with rolling, and the entrance gate was built to allow easier access into the trap than is provided by a funnel.

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MATERIALS AND METHODS

The trap's body, illustrated in Figure 1A, B, is a flat, 1-liter can 4 5/8 inches (11.7 cm) wide x 6 7/8 inches (17.5 cm) long x 2 3/8 inches (6 cm) thick. A 7/16 inch (1.1 cm) hole is bored in the center of the can's top to hold the light unit. A rectangular opening 3 inches (7.6 cm) wide is cut in the can's bottom to receive the entrance gate. A galvanized wire for support of the power cord is strung from end to end, held by sheet metal screws as shown in Figure 1A. When all openings have been cut, the inside of the trap is given a coat of gloss white, oil-based paint to improve light output and retard rusting.

The entrance gate is constructed from 1/8 inch (3.2 mm) and 1/4 inch (6.3 mm) clear acrylic plastic sheet. Details of gate construction are shown in Figure 2. The acrylic is cut to size with a table saw, and the gate is temporarily assembled with tape. The pieces of the gate are welded together by applying solvent[4] to joints. When all solvent has evaporated, about 45 minutes, the tape is removed and the gate is permanently installed in the painted trap using silicone rubber as adhesive.

Power is provided by two 1.5 volt "D" cells in a plastic holder (Radio Shack # 270-386; Figure 1 C), which is wired to the light unit with 8 feet (3.8 m) of plastic-covered, 22 gauge stranded, 2-conductor wire. Near the trap this wire is tied to the galvanized support wire. No switch is necessary; a battery is removed to break the circuit. All electrical connections should be soldered with rosin core solder and must be thoroughly covered with waterproof material to avoid problems with electrolysis, which will quickly destroy bare wires. A covering of either "5-minute"-type epoxy or silicone rubber will provide adequate protection; plastic tape will not.

The lamp used as the attractor is a clear 3 volt bulb of the "grain-of-wheat" type, drawing 23 mA (Chaney Electronics #C22505[5]). A pair of batteries will operate a lamp of this amperage for at least 24 nights; the lamps last indefinitely. This style of lamp has 2 protruding wire leads which are soldered directly to solid copper wires thrust lengthwise through a #00 neoprene stopper. A 9mm x 30mm shell vial is put over the lamp onto the end of the stopper. When the light unit is in place in the trap the neoprene stopper supports it (Figure 1B). The complete trap can be built for about $6 per unit, exclusive of batteries.

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[4]Use either methylene chloride, or a proprietary acrylic solvent such as "Weld-On 3" (Industrial Polychemical Service, Gardena, California, 90247), available where acrylic plastic sheet is sold.

[5]Chaney Electronics, Denver, Colorado, apparently is out of business and these lamps are no longer available. Radio Shack carries a *1.5 volt* lamp of the same size, style and amperage (#272-1139) which may be substituted. Light output is the same as the Chaney lamps. To use this lamp, change the battery holder to Radio Shack #270-403; a single "D" cell holder.

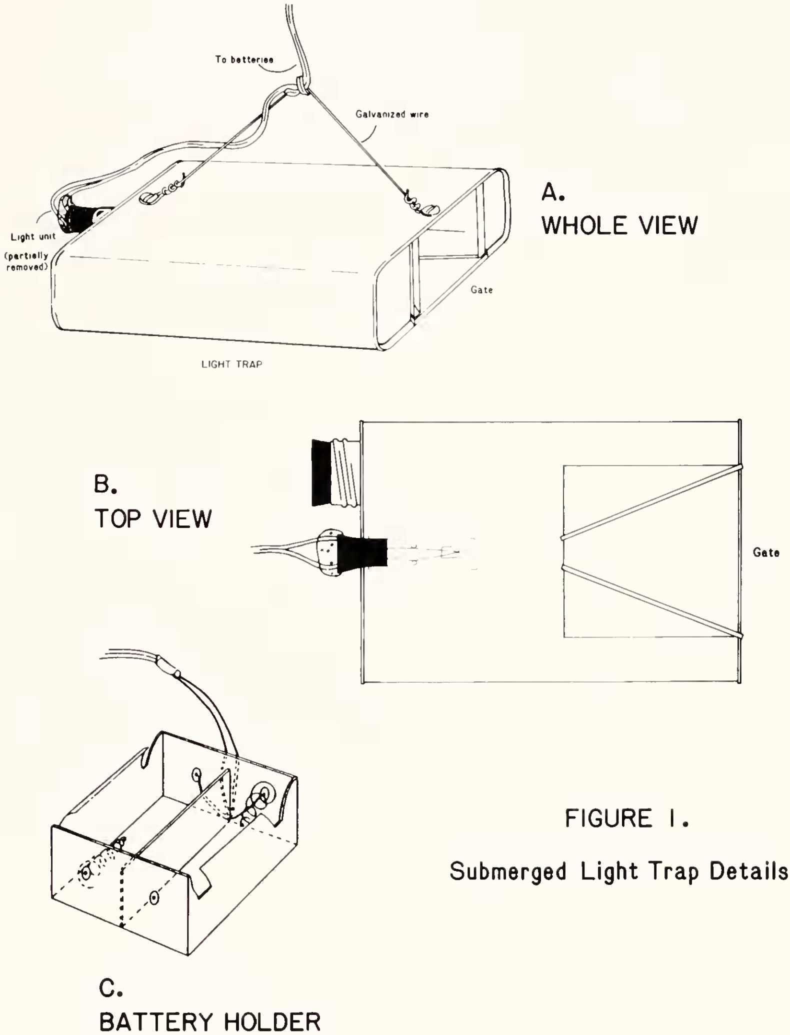

FIGURE 1.

Submerged Light Trap Details

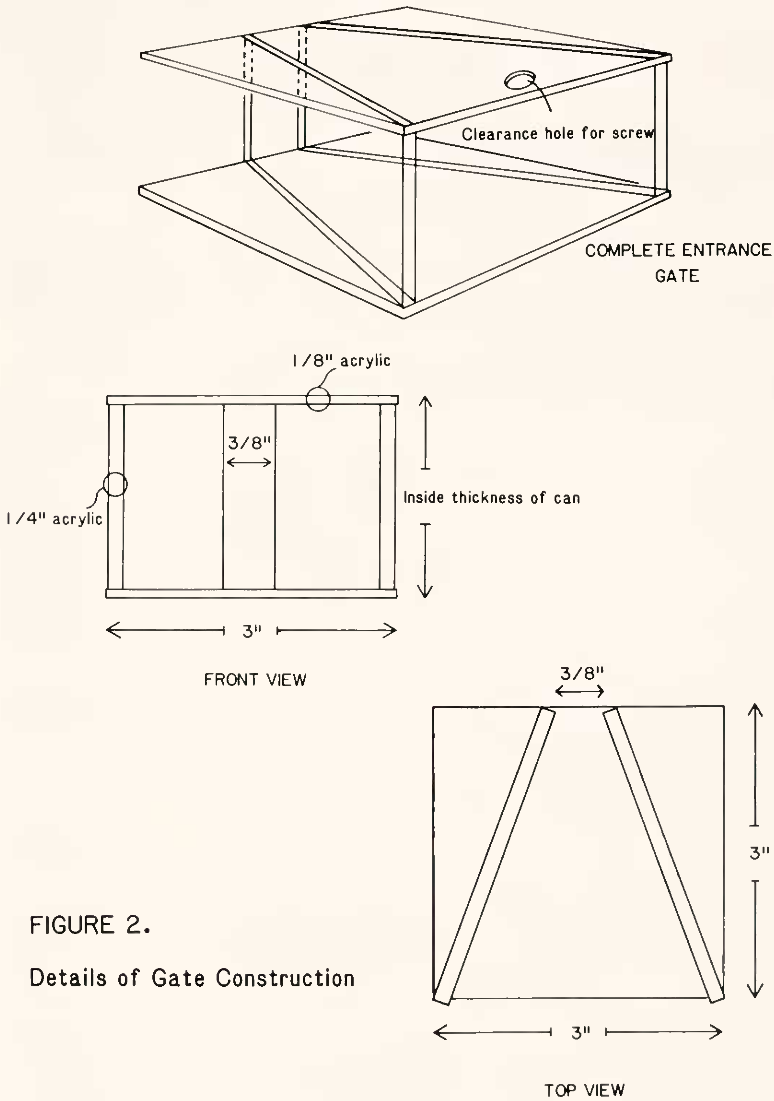

FIGURE 2.

Details of Gate Construction

DISCUSSION

In use, traps are filled with habitat water while upright, then submerged, and positioned horizontally. Normally, this allows a bubble of air to remain trapped in the container. The bubble permits emergence of adults, and allows some survival of surface-breathing forms if their numbers are not too great. If necessary, small rocks may be used to position and anchor traps. The batteries are installed in the holder, which is either laid on shore, or fastened to a stake beside the trap. Use of a stake helps prevent trap loss due to unexpected flooding, or wave action.

At the end of a trapping session traps are taken from the water with the gate upward, to retain the catch. The lamp is checked to make sure it is still on, which indicates it operated during the trapping period. Water and trapped insects are poured out the container's original opening into a pan for sorting. The original screw cap, or a neoprene stopper may be used to close the opening during trapping.

This trap design has been effective in a variety of lentic and lotic habitats, capturing both mature and immature insects. Mature insects taken are those which normally swim beneath the surface, e.g. Dytiscidae, Notonectidae, and Corixidae. Immature forms include larvae, naiads, nymphs and pupae. Appreciable numbers of motile dipteran and trichopteran pupae are taken. These pupae frequently moult to adults after they have entered the trap, as indicated by presence of adults plus pupal exuviae. Corixidae are especially attracted; 1,791 nymphs and adults were captured in one trap during a single night. Larvae of several dipteran families also respond well to the trap. Maximum one-night catches for single traps included 680 Chironomidae, 614 Chaoboridae, and 38 Ceratopogonidae. In some habitats small fish enter the traps and feed on trapped insects. Where fish are present it may be desirable to fix a piece of 1/4 inch (6.3 mm) mesh screen over the entrance of the gate to exclude them. The alternative used here was to dissect trapped fish and examine their stomach contents.

Table 1 presents a listing of insect taxa captured with the subaquatic trap described here. It includes references to previous reports of taxa captured in subaquatic traps. The trap has not only collected insects from many families reported in the literature as entering subaquatic light traps, but has extended the list. New records are COLEOPTERA: Noteridae; DIPTERA: Simuliidae, Tabanidae; EPHEMEROPTERA: Ephemerellidae, Heptageniidae, Leptophlebiidae; TRICHOPTERA: Hydroptilidae, and PLECOPTERA. The Simuliidae, Tabanidae and Plecoptera were collected in small numbers (<5 individuals) in only one of the habitat types trapped. The other families were collected in quantity (>10 individuals) in several habitats.

Table 1. Taxa of aquatic insects captured in subaquatic light traps.

Taxon	This Trap	Other Traps
Coleoptera		
Dytiscidae	+	Hungerford *et al.*, 1955; Carter & Paramonov, 1965; Espinosa & Clark, 1972; Brown, 1976
Elmidae		Hungerford *et al.*, 1955
Gyrinidae		Hungerford *et al.*, 1955
Haliplidae	+	Hungerford *et al.*, 1955; Espinosa & Clark, 1972
Hydrophilidae	+	Hungerford *et al.*, 1955; Washino & Hokama, 1968; Espinosa & Clark, 1972; Brown, 1976
Limnebiidae		Hungerford *et al.*, 1955
Noteridae	+	
Diptera		
Ceratopogonidae	+	Hungerford *et al.*, 1955; Washino & Hokama, 1968
Chaoboridae	+	Baylor & Smith, 1953; Hungerford *et al.*, 1955
Chironomidae	+	Hungerford *et al.*, 1955; Washino & Hokama, 1968
Culicidae	+	Hungerford *et al.*, 1955; Husbands, 1967; Washino & Hokama, 1968; Brown, 1976; Weber, 1985
Simuliidae	+[a]	
Tabanidae	+[a]	
Tipulidae		Washino & Hokama, 1968
Ephemeroptera	+[b]	Espinosa & Clark, 1972[b]
Baetidae	+	Washino & Hokama, 1968
Caenidae		Hungerford *et al.*, 1955
Ephemerellidae	+	
Heptageniidae	+	
Leptophlebiidae	+	
Hemiptera		
Belostomatidae		Hungerford *et al.*, 1955; Washino & Hokama, 1968; Espinosa & Clark, 1972; Brown, 1976
Corixidae	+	Hungerford *et al.*, 1955; Carter & Paramonov, 1965; Washino & Hokama, 1968; Espinosa & Clark, 1972; Brown, 1976
Gerridae		Hungerford *et al.*, 1955; Brown, 1976
Mesoveliidae		Hungerford *et al.*, 1955
Nepidae		Hungerford *et al.*, 1955
Notonectidae	+[b]	Hungerford *et al.*, 1955; Washino & Hokama, 1968; Espinosa & Clark, 1972; Brown, 1976
Pleidae		Hungerford *et al.*, 1955
Veliidae		Hungerford *et al.*, 1955
Odonata		Hungerford *et al.*, 1955[b]; Espinosa & Clark, 1972[b]; Brown, 1976[b]
Plecoptera	+[ab]	
Trichoptera	+[ab]	Hungerford *et al.*, 1955[b]
Hydroptilidae	+	
Leptoceridae		Baylor and Smith, 1953

[a]Less than 5 individuals.
[b]Specimens identified only to order.

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